Transmission Cost Allocation (and Strategic Benefits) Methodologies

Transmission Research Program Colloquium
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Research Objectives

Summarize research results on benefits of transmission projects

Review methodologies being used for transmission project benefit quantification – *focus of today's presentation*

Review and summarize benefit analysis of recent transmission projects

Present research results to improve benefit quantification methods – *focus of today's presentation*

Outline approaches to apply improved benefit quantification methods to:

- Evaluate project cost effectiveness
- Allocate transmission costs among participants
- Develop framework for cost recovery

Project Technical Advisory Committee

- DeDe Hapner, Vice President, FERC and ISO Relations, Pacific Gas & Electric
- Les Starck, Director of T & D Business Unit, Southern California Edison
- Caroline Winn, Director of T&D Asset Management, San Diego Gas & Electric
- Sean Gallagher, Director of Energy Division, California Public Utilities Commission
- Steve Ellenbecker, Energy Advisor to Wyoming Governor Freudenthal
- Jim Bushnell, Research Director, UC Energy Institute

Project Schedule

- Project Start -- October 2006
- Outreach–Frontier Line meetings -- Nov 06 & Jan 07
- CEC Technical Advisory Committee -- January 2007
- Public Presentation of Interim Findings -- May 2007
- Project Technical Advisory Committee [PTAC] -- September 2007
- Revision based on PTAC Input -- October 2007
- Outreach to CEC, CAISO, CPUC, WECC/TEPPC -- November 2007 to June 2008
- Final Research Results and Report -- August 2008

Topics Addressed During Research

Transmission Technologies – How do they impact benefits, influence cost allocation, impact stakeholders?

Industry and Regulatory Changes – How have things changed and what does it mean for large regional transmission projects?

Review of Other Regions and Industries – What can we learn and apply for transmission in California and the Western Interconnection?

Benefit Quantification, Cost Allocation and Approval Processes

- Focus of today's briefing: Benefit Quantification

Benefit Quantification Methods

- Production simulation models are generally used for transmission project benefit quantification
- CAISO developed the Transmission Economic Assessment Methodology (TEAM) for benefit analysis of major transmission projects
- In the TEAM approach, benefits are measured separately for consumers, producers, and transmission owners in different regions
- TEAM incorporates bid-cost markup in the analysis to reflect functioning of markets
- Uncertainties are considered through a wide range of future system conditions – dry and wet hydro, demand scenarios, gas price scenarios, generation addition scenarios
- Expected range of benefits is computed. Insurance and strategic value of transmission is discussed
- Methodology has been applied to evaluate Palo-Verde Devers No. 2 and other projects
- TEAM was filed with the CPUC in June 2004
- TEAM approach is comprehensive and incorporates many enhancements to traditional production simulation analysis

Assessment of Current Benefit Quantification Methods

Models understate benefits of long life assets (50+years) by discounting future benefits using high interest rate based on cost of capital – essentially reducing the impact of benefits beyond the first 10-years

Models utilize expected value approach that tends to minimize impact of high impact but low probability events

Models are data intensive – require assumptions about future generation mix, fuel prices, and transmission network

Models are static with no feedback – assume no change in investment for new generation resulting in a zero sum benefit distribution game, for example, Devers-Palo Verde No. 2

Extreme market volatility and multiple contingency system events which can be very costly and risky to society are not captured in current models

- 2001 California market dysfunction -- $20-40 billion
- 2003 Northeast Blackout -- $5-10 billion

Research Building Blocks for Study

Benefits	**Research to identify and quantify full range of benefits, including strategic benefits**
Cost and Benefit Allocation and Cost Recovery	**Utilization of improved benefit quantification methods for cost and benefit allocation and cost recovery**
Planning Process	**Improve transmission planning and approval process**

Focus of this briefing: the first block

Transmission Benefits Can be Grouped into the Following Categories

Primary Benefits	Improve network reliability – meet reliability standards and guidelines Lower cost of energy and capacity adjusted for transmission losses as a result of reduced congestion, access to lower cost resources, and increased inter-regional power trading
Strategic Benefits	Renewable resource development and integration Fuel Diversity – lower natural gas consumption, gas prices Emissions reduction/environmental Market Power Mitigation Insurance against contingencies Development of new capacity and inter-regional trading
Extreme Event Benefits	Reliability -- improve network load carrying capacity and ability to reduce or mitigate impact of extreme events resulting from multiple contingencies Market volatility – societal benefit of reduced vulnerability to extreme price volatility due to long term outages and catastrophic events

In addition, there are secondary benefits related to infrastructure development, economic development, tax base, use of right-of-way, and new investment. However, the research did not address quantification of secondary benefits.

Research Recommendations on Methods to Quantify Strategic Benefits of Transmission Projects

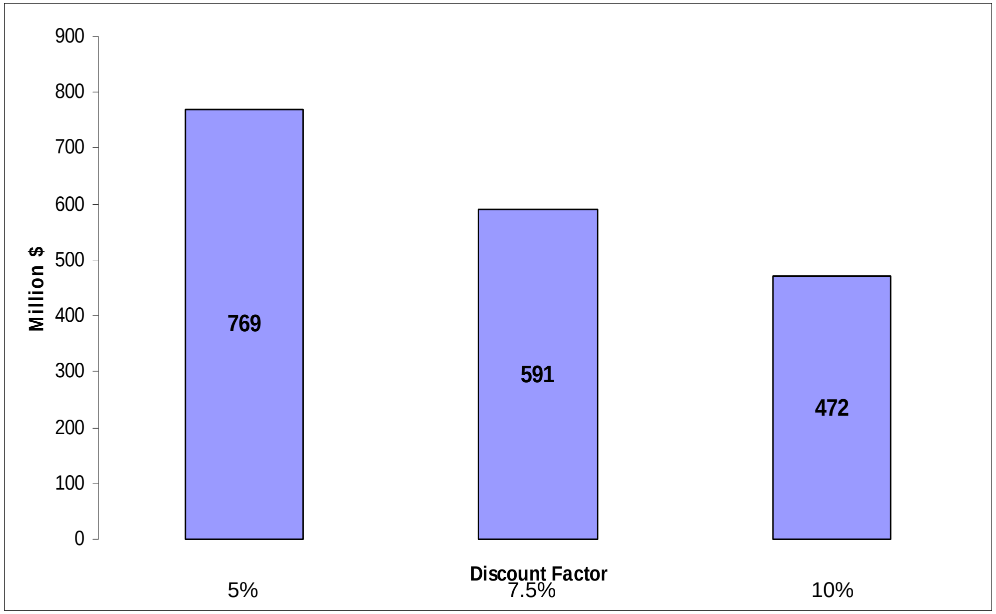
Public Good – long asset life benefit	Use social rate of discount to calculate the present value of benefits for the new transmission projects since transmission system is a "public good," assets are long life, and benefits accrue over time
Fuel Diversity Benefit	Assess impact of significant renewable resources development upon price of natural gas
Reliability Improvement from Extreme System Multiple Contingency Events	Assess impact of transmission project in mitigating N-3, N-4, N-5, N-6 events Incorporate "transmission reserve margin" concept similar to spinning or planning reserves for generation
Risk Mitigation for Low Probability/High Impact Extreme Market Events	Estimate risk mitigation benefit to society Research use of value at risk, option value, and insurance premium approaches
Dynamic Analysis -- construction of new generation	Recognize changing benefit streams over asset life due to construction of new generation in exporting region

Public Good – Social Rate of Discount

In a restructured market, the high voltage transmission lines have become a *Public Good*. The benefit from a new project cannot be denied to any retail customers nor generation owners.

For calculating the present worth of a *Public Good* project, one should use the *social rate of discount* instead of regulated rate of return (opportunity cost of capital)

For a project with 30-years of economic life and a constant annual benefit of $50 million, the present worth of benefits will be:



Note: The social rate of discount is a function of per capital consumption growth, the elasticity of the marginal utility of consumption and the probability of survival of the *average consumer* from one period to the next. For U.S. the social rate of discount is around 5%.

Fuel Diversity Benefit -- Illustrative

Integrate 4,500 MW of renewables (e.g., Tehachapi Wind)	
Estimated annual production	$\simeq$ 13 Billion KWh (approximately 35% CF)
Electricity production Using Gas in California	
◻ Base case	$\simeq$ 107 Billion KWh
◻ With Renewables	$\simeq$ 94 Billion KWh
Reduction in Gas for Power Plants	$\simeq$ 12 %
Price elasticity of natural gas	1% demand reduction equals 0.8 – 2% price reduction*
Gas for electric production as a % of CA gas consumption	$\simeq$ 40 %
% Reduction in gas usage	= .12 * .4 $\simeq$ 4.8%
Gas Price Reduction (assume 1% for 1% reduction)	= 4.8%
Gas Price	
◻ Base Case	\$6/M^2BTU
◻ With Renewables	\$5.70/M^2BTU
Cost Savings for remaining 94 Billion KWh assuming average 9,000 BTU/KWh	= 94 Billion KWh * 9,000 BTU/KWh X \$0.30/M^2BTU $\simeq$ \$250 Million/year

Note: Including price impact on non-electric sector, benefit will be 2.5 times, or $625 million.
Illustration ignores timing and present value for simplicity.

*Wiser, Bolinger, and St. Clair, January 2005, Easing the Natural Gas Crisis: Reducing Natural Gas Prices through Increased Deployment of Renewable Energy and Energy Efficiency

Quantification of Benefits of Mitigating Extreme Events

Extreme Reliability Events -- Multiple Contingency, Cascading Events

- Transmission system performance is analyzed for N-1 and N-2 events but not for extreme events
- Methods to assess value of transmission in reducing magnitude and impact of multiple contingencies (N-3, 4, 5, 6) need to be researched and quantified
- Quantification approach should focus on network carrying capacity under multiple contingencies
- Alternatively, a policy or expert consensus approach can be used for “value equals xx% of cost” of project

Extreme Market Volatility

- Insurance industry utilizes extreme event probability distribution eg hurricane and earthquake insurance
- Such approaches are data dependent
- In the absence of such data to calculate insurance value of avoiding extreme price volatility, a policy consensus approach can be used
- Policy consensus can be encouraged via polling of policy makers or more formal approaches such as the Delphi method or risk tolerance and value at risk analysis
- Social rate of discount instead of cost of capital can be used to calculate the present value of the stream of future benefits for transmission project similar to other public projects
- Possible calculation “insurance value equals xx% of project cost”

Incorporating Dynamic Planning Benefits

Analysis Method

- Define base case for studies
- Estimate benefits with proposed transmission project
- Modify future year base case to reflect dynamic impacts – for example new generation capacity construction
- Estimate change in benefits
- Assess other dynamic factors either individually or using scenarios and weights

Methods for Stakeholder and Policy Consensus to Value Strategic Benefits of Transmission Projects

- **Stakeholder Consensus** to incorporate societal or strategic benefits

Utilize Delphi or other stakeholder consensus building approaches to develop an agreed "societal value" for transmission for example, a fixed percentage of transmission project cost

- **Resource Portfolio Analysis**

Methodologies to evaluate transmission project benefits using portfolio analysis

Recommendations To Augment Benefit Quantification Methods

Public Good

Use of social rate of discount to calculate the present value of benefits for the new transmission project

Fuel Diversity

Include the benefit from potential decrease of natural gas price due to the construction of a new transmission project that integrates a significant amount of new renewable resources

Low Probability / High Impact Events

Add risk mitigation benefit to society for low probability/high impact extreme market events and extreme system multiple contingency events – scenarios or Delphi method for stakeholder consensus

Recommendations for Benefit Quantification Methods Research

Dynamic Analysis

Recognize the impact of new transmission projects on construction of new generation capacity in exporting regions

Portfolio Analysis

Adapt portfolio analysis methods utilized in financial industry to transmission – construct and assess performance of portfolios including demand response, new generation (renewables and fuel based), new transmission, energy conservation

Quantification of Extreme Event Benefits (Insurance Value)

Reliability – benefit of new transmission in reducing blackout footprint due to extreme (N-n) events and societal value of reduced vulnerability

Market Volatility -- benefit of new transmission in reducing market volatility due to extreme (N-n) events and societal value of reduced vulnerability to run away market prices

Follow-up - Next Steps

Presentation to CPUC has led DRA to append an earlier version of this PIER briefing to its opening comments on I.08-03-010/R.08-03-009 to promote the development of transmission infrastructure to provide access to renewable energy resources for California – CEC has indicated its desire to further support findings from this research in this proceeding

Presentation to WECC/TEPPC has led to follow-up from DOE, Midwest ISO, Southwest Power Pool, and American Electric Power